CONTINUOUS PRODUCTION OF MOLDED PLASTIC CONTAINERS

The present invention is directed to blow molding plastic containers, and more particularly to a system and method for continuous production of plastic containers from polymer in melt phase.

Background and Summary of the Invention

Preforms for blow molding plastic containers typically are produced in batch processes, in which one or more solid phase polymers such as polyethylene terephthalate (PET) are melted and injected into preform molds. The injection molded preforms are blow molded to form plastic containers, usually at some later time. A general object of the present invention is to provide a system and method for continuous production of blow molded plastic containers from molten polymer.

A system for making plastic containers in accordance with one presently preferred aspect of the invention includes a source for providing a continuous stream of molten plastic, and a cutter for severing a continuing series of individual mold charges from the continuous molten plastic stream. A compression molder includes a plurality of compression molds arranged in a continuing series for receiving the mold charges in sequence and compression molding the mold charges into a continuing series of individual plastic container preforms. A blow molder includes a plurality of blow molds arranged in a continuing series for receiving the individual plastic container preforms in sequence and blow molding the preforms into a continuing series of plastic containers. A common drive coordinates continuous and synchronous operation of the molten plastic source, the cutter, the compression molder and the blow molder to provide the continuing series of plastic containers from the continuous stream of molten plastic.

A method of making plastic containers in accordance with another aspect of the present invention includes providing a continuous stream of molten plastic, cutting the continuous stream into individual mold charges , and transferring the mold charges in sequence into a continuing series of compression molds. A continuing series of plastic container preforms are compression molded in the compression molds, and are transferred in sequence to a continuing series of blow molds. A continuing series of plastic containers is formed in the blow molds and removed in sequence. The step of transferring the preforms to the blow molds preferably includes conditioning the preforms preparatory to blow molding.

A system for making plastic containers in accordance with a third presently preferred aspect of the invention includes a source for providing a continuous stream of molten plastic, and a compression or injection molder for molding a continuing series of individual plastic container preforms. A blow molder includes a plurality of blow molds arranged in a continuing series for receiving the individual plastic container preforms in sequence and blow molding the preforms into a continuing series of plastic containers. A common drive coordinates continuous and synchronous operation of the molten plastic source, the preform molder and the blow molder to provide the continuing series of plastic containers from the continuous stream of molten plastic.

Brief Description of the Drawing

The invention, together with additional objects, features, advantages and aspects thereof, will be best understood from the following description, the appended claim and the accompanying drawing, which is a schematic diagram of a system for making plastic containers in accordance with one presently preferred embodiment of the invention.

Detailed Description of Preferred Embodiments

The drawing illustrates a system 10 for making plastic containers in accordance with a presently preferred embodiment of the invention. An extruder 12 receives one or more

plastic resin materials from associated hoppers 14. Extruder 12 is driven by a motor 16 to provide a continuous stream of plastic resin material in melt phase to an extrusion nozzle 18. The plastic resin material may comprise molten PET, for example, to fabricate containers of monolayer PET construction. As an alternative, multiple extruders 12 can feed associated streams of molten plastic material to nozzle 18, with nozzle 18 being constructed to provide a continuous stream of layered resin material for fabrication of multilayer containers. Such containers may have inner and outer surface layers of PET construction, for example, and one or more intermediate layers of barrier material, such as ethylene vinyl alcohol (EVOH) or nylon, to retard migration of gas, water vapor and/or flavorants through the container wall. As another alternative, extruder 12 can be replaced by a reactor within which the resin material, such as PET, is produced by melt phase polymerization.

The continuous stream of molten plastic resin is fed to a pellet cutter 20 and a transfer mechanism 22 for severing a continuing series of individual mold charges from the continuous stream of plastic resin, and transferring the mold charges to individual molds 26 of a compression molder 24. Compression molder 24 preferably includes a plurality of compression molds 26 arranged in a continuous series for receiving the mold charge pellets in sequence and compression molding the mold charge pellets into a continuing series of individual plastic container preforms. The compression molds 26 preferably are carried by a rotatable turret 28, which is driven in synchronism with rotation of cutter 20 and transfer mechanism 22. Compression molder 24, transfer mechanism 22 and cutter 20 may be as disclosed in U.S. Patent 5,866,177 or 6,349,838, for example, the disclosures of which are incorporated herein by reference.

After the preforms have been compression molded and cooled sufficiently to retain their shape, the preforms are individually removed from molds 26 and transferred by wheels or

other suitable transfer devices 30, 32 to a conditioning stage 34. At conditioning stage 34, the preforms are fed in a loop 36 around a wheel 38, and then back to a preform transfer wheel 40. During travel in loop 36, the preforms are allowed to cool from the temperature at which they exit compression molder 24 to a temperature suitable for blow molding. For example, PET preforms may be withdrawn from compression molder 24 at a temperature of about 280 to 300° F, and allowed to cool at conditioning stage 34 to a temperature of 210 to 220° F suitable for blow molding. Conditioning stage 34 may also include selective heating to obtain a temperature profile in the preform suitable for blow molding, and may include crystallization of portions of the preform, such as the preform finish. Conditioning stage 34 may comprise a rotating wheel or turret, or an extended conveyor loop along which the preforms are carried.

After preform conditioning at stage 34, the preforms are transferred to a blow molder 42 by the wheel, turret or other suitable transfer device 40. Blow molder 42 includes a continuing series of blow molds 44 mounted on a turret or the like 46 for receiving the preforms in sequence, and blow molding the preforms into containers of desired geometry. (Reference to compression molding or blow molding preforms or containers "in sequence" does not mean that the preforms or containers are formed one at a time. Indeed, compression molder 24 and/or blow molder 42 preferably includes facility for compression molding or blow molding multiple preforms and containers at each mold stage.) Blow molder 42 may be of the type disclosed in U.S. Patents 5,683,729, 5,863,571 and 6,168,749, the disclosures of which are incorporated herein by reference. Following blow molding, the containers are transferred by a wheel, turret or other suitable device 48 to a conveyor 50 for moving the containers to subsequent manufacturing stages, such as labeling (decorating), filling, capping and crating stages. As an alternative, the subsequent stages may be linked directly to blow molder 42 to form an integrated sequential system.

Additional stages may be added for operating on the finish of the preform or container. For example, the finish can be crystallized, as illustrated for example in U.S. Application No. 10/122,901 filed April 12, 2002. As another example, finish rings can be added to the finish neck prior to or subsequent to blow molding, as disclosed for example in U.S. Application Serial Nos. 10/375,737, 10/403,415, 10/375,736, 10/351,671 and 10/375,758. Other forms of finish manipulation could be implemented.

A common or integrated drive/control mechanism 52 is connected to the drive 16 of extruder 12, the drive of cutter 20 and transfer wheel 22, the drive of compression molder turret 28, the drive of conditioning stage 34, the drive of blow molder turret 46, to the drive of conveyor 50 and the drives of the various transfer devices to operate and control these drive mechanisms continuously and in synchronism for continuous production of containers at the output of blow molder 42 from a continuous stream of molten plastic at the output of extruder 12. Drive/control mechanism 52 may comprise servo control electronics for synchronizing operation of servo motors connected to extruder 12, compression molder 28, conditioning stage 34, blow molder 42 and conveyor 50. As an alternative, drive/control 52 may comprise a single motor that is connected by suitable drive mechanisms, such as belts, gears or chains, to the operating mechanisms of the extruder, compression molder, conditioner, blow molder and conveyor. In either event, the extruder, preform compression molder, preform conditioner, container blow molder and conveyor are operated continuously and synchronized with each other for continuous production of containers from the molten output of the extruder.

There have thus been disclosed a system and method for making plastic containers that fully satisfy all of the objects and aims previously set forth. The system and method of the invention possess a number of advantages over the prior art, including but not limited to: (1) Reduced intrinsic viscosity (IV) loss in the preform, yielding better part quality and the

opportunity to use lower cost material. (2) Reduced energy required because the preform does not need to be reheated from room temperature prior to blow molding. (3) Reduced cost of customizing the system to permit addition of modules for finish manipulation, finish crystallization, container decoration, filling and capping, etc. The invention has been described in conjunction with one presently preferred embodiment, and a number of modifications and variations have been discussed. Other modifications and variations will readily suggest themselves to persons of ordinary skill in the art. The invention is intended to embrace all such modifications and variations as fall within the spirit and broad scope of the appended claims.